ABSTRACT

Classification:

Title: The application of LANDSAT data from collection platforms and LANDSAT IMAGERY for Fire Management, Everglades National Park, Florida.

Authors: L. J. Swayze, W. L. Bancroft, A. L. Higer and E. H. Cordes

Month and year: October 1975

Pages: 15

Illustrations: 3

Tables: 0

References: 4

Descriptors: LANDSAT, IMAGERY, Data collection platforms, Fire management, Drought Index.

Indentifiers: Soil moisture, water level, rainfall, air temperature.

Abstract: Using LANDSAT IMAGERY and the data from the data collection platforms the important parameters of fire prescription (water level, rainfall, air temperature and soil moisture) shall be monitored for Everglades National Park at two locations. The U.S.G.S., Water Resources Division, currently has seven Landsat stations collecting stage and rainfall in the park. Two key stations, one on the west boundary and the other on the east boundary of the park, are electronically interfaced to measure air temperature and soil moisture in addition to rainfall and water level. Using rainfall and maximum air temperature for the Landsat stations, the drought index will be calculated. By correlating drought index and soil moisture, the flammability of the soil will be known for the east and west park boundaries.

When surface water control gates are closed at the S-12 structures, discharge of surface-water to the western boundary of the park is halted. Groundwater levels drop rapidly and fire hazards are increased.

Report to be published: NTIS 21580

LANDSAT TYPE I PROGRESS REPORT

By

L. J. Swayze, W. L. Bancroft, A. L. Higer and E. H. Cordes

a. TITLE: THE APPLICATION OF LANDSAT DATA FROM COLLECTION PLATFORMS AND LANDSAT IMAGERY FOR FIRE MANAGEMENT, EVERGLADES NATIONAL PARK, FLORIDA.

b. GSFC ID of P. I. I 414

c. In August 1975, Landsat imagery was received at the U.S. Geological Survey, Miami, Fl. a subdistrict office. Not all the magnetic tapes for the imagery had been received at the time this report was prepared; however, the U.S. Geological Survey and Bendix Aero Space Division have developed the necessary algorithms to locate ground stations within the picture elements that represent different water depths and vegetative cover types. The initial computer runs have indicated that we can determine eight different ranges of water depths within a 900-square-mile area of the Everglades.

Soil moisture probles (boyucous blocks) were installed at two stations, 205 and 206, during September 1975. The electronics for interfacing the probe to the DCP (Data Collection Platforms) have been designed. Assembly has taken longer than expected but should be completed soon.

d. During the last reporting period new tipping bucket rain-gage counters were installed at all stations. Developed by Ed Cordes, U.S. Geological Survey, Miami, the counters have been very reliable during the last 6 months.

Recorders and rain gageshave been running on solar panels on stations 201 and 202 in Everglades National Park. Data recovery from these stations has been complete since their installation four months ago.

e. In a climate in which there is a wet and dry season, soil moisture becomes a critical factor influencing the effects of fire on vegetation and animal populations. Davis (1943) states that: "... the types of vegetation in southern Florida are probably as much influenced by the amount of soil water as any other condition of the physical environment."

The amount of water in organic soils is an indicator of potential fire damage to flora and fauna. Fires that occurs during the wet season have little serious effect on flora and fauna because most of the area is flooded. During the dry season the surface water levels decline and the organic soils become dry and combustible. During severe droughts, hammock, bayhead and saw-grass peat soils may ignite and burn slowly destroying plant root systems and all animal life living in the soils. This is apt to occur when soil moisture percentages are 30 percent or less. (Craighead, 1971; 1974). The soil moisture is one of the parameters used in fire prescription.

Fire prescription is a set of parameters which describes the actions to be taken against a fire. Fire prescription (Keetch and Byram, 1968) uses several indicators to define potential fire damage. These indicators dictate whether a fire will be allowed to burn or whether it will be suppressed. For example, if conditions are favorable, some fires will be allowed to burn out. The two most important parameters of the fire prescription are drought index and soil moisture; other parameters include fire location and water level. Drought index as defined by Keetch and Byram (1968) is:

> "A number representing the net effect of evapotranspiration and precipitation in producing accumulative moisture deficiency in deep duff or upper soil layers ... it is a quantity that relates to the flammability of organic material in the ground."

"Drought index" is a number on a scale of 0 to 800 which expresses soil moisture deficiency in hundredths of an inch. The index scale is based on 8 inches of water in storage available for transpiration where zero is the point of no moisture deficiency and 800 represents the maximum drought possible. At any point along the scale, the index number indicates the amount of rainfall (in hundredths of an inch) that is required to reduce to zero, or increase the soil moisture content to saturation.

Using DCP's to monitor soil moisture, rainfall, and maximum air temperature, a correlation between drought index and soil moisture can be plotted to help predict wild fires in Everglades National Park (fig. 1). Figure 2 shows the calculated drought index for June 1973 to July 1974 at Tamiami Ranger Station.

Using Landsat imagery and Data Collection Platforms (DCP's), the important parameters of fire prescription are monitored for Everglades National Park. The U.S. Geological Survey currently has seven Landsat stations collecting stage and rainfall data in the park (fig. 3). Two key stations, 205 and 206 have had soil moisture probes installed in September 1975 and will have air temperature probes installed. The soil moisture probes are boyucous gypsum blocks which are interfaced electronically to the DCP. By correlating drought index and soil moisture, the flammability of the soil is known for the hammocks in the area of stations 205 and 206.

When surface-water control gates are closed at the structures S-12-A and B on the northern boundary of the park (fig. 3), discharge of surface water to the area west of Shark River Slough is halted. Ground-water levels drop rapidly and fire hazards are increased. The distribution of water within Everglades National Park varies widely depending upon season and the control of surface-water discharge through the S-12 structures (figs. 4 - 6). Using the DCP's to monitor soil moisture, fires, as described in the following paragraphs, could have been averted.

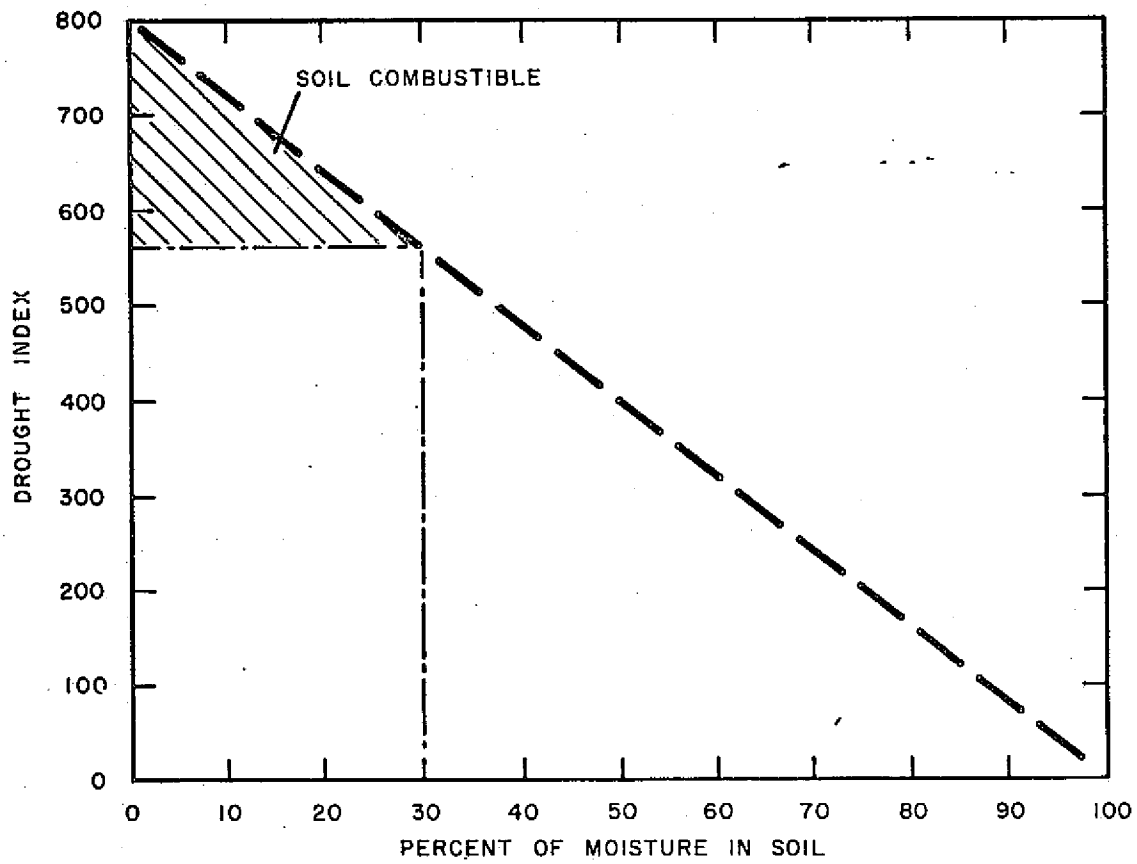

Figure 1.--The dashed line represents a theoretical curve for drought index versus percent of moisture in the soil. Air temperature and rainfall data, monitored by DCP's, is used to calculate drought index. By comparing the drought index to soil moisture values, monitored by DCP's, a real relationship between drought index and soil moisture will be obtained for soils in Everglades National Park.

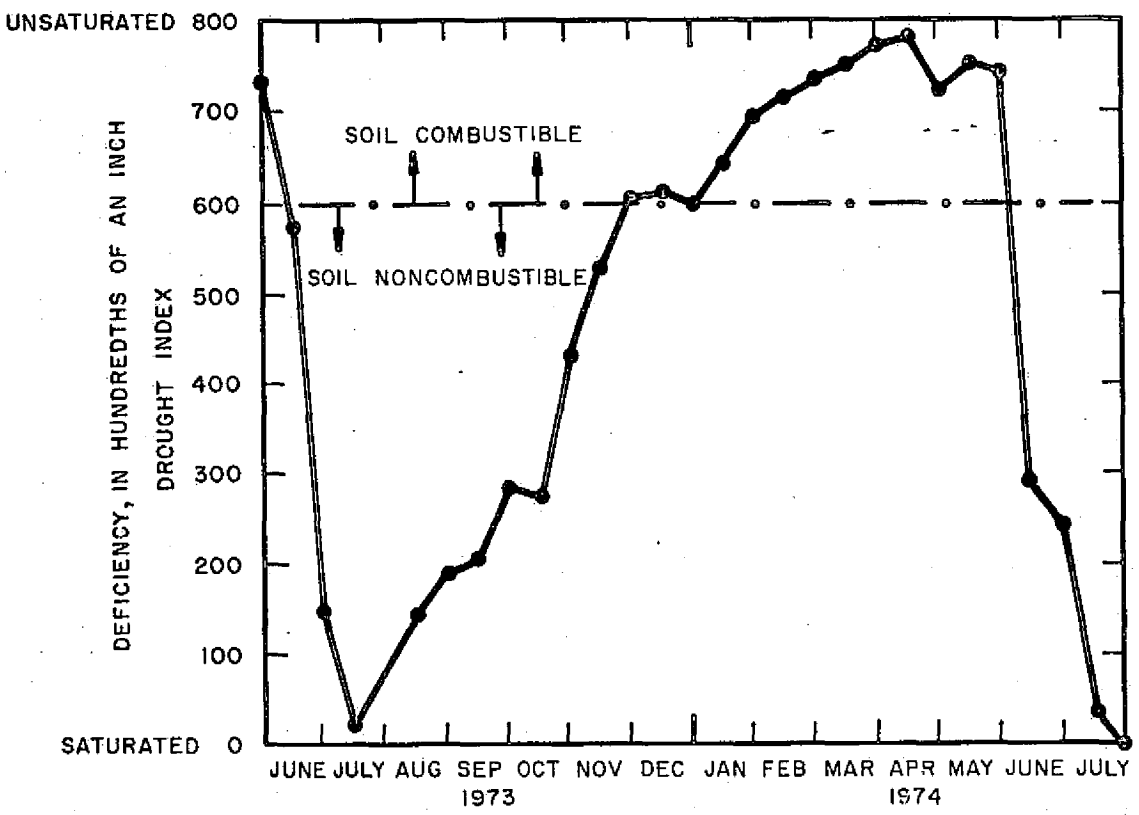

Figure 2.--Drought Index for Tamiami Ranger Station June 1973 to July 1974 (National Park Service data, Bancroft, 1975).

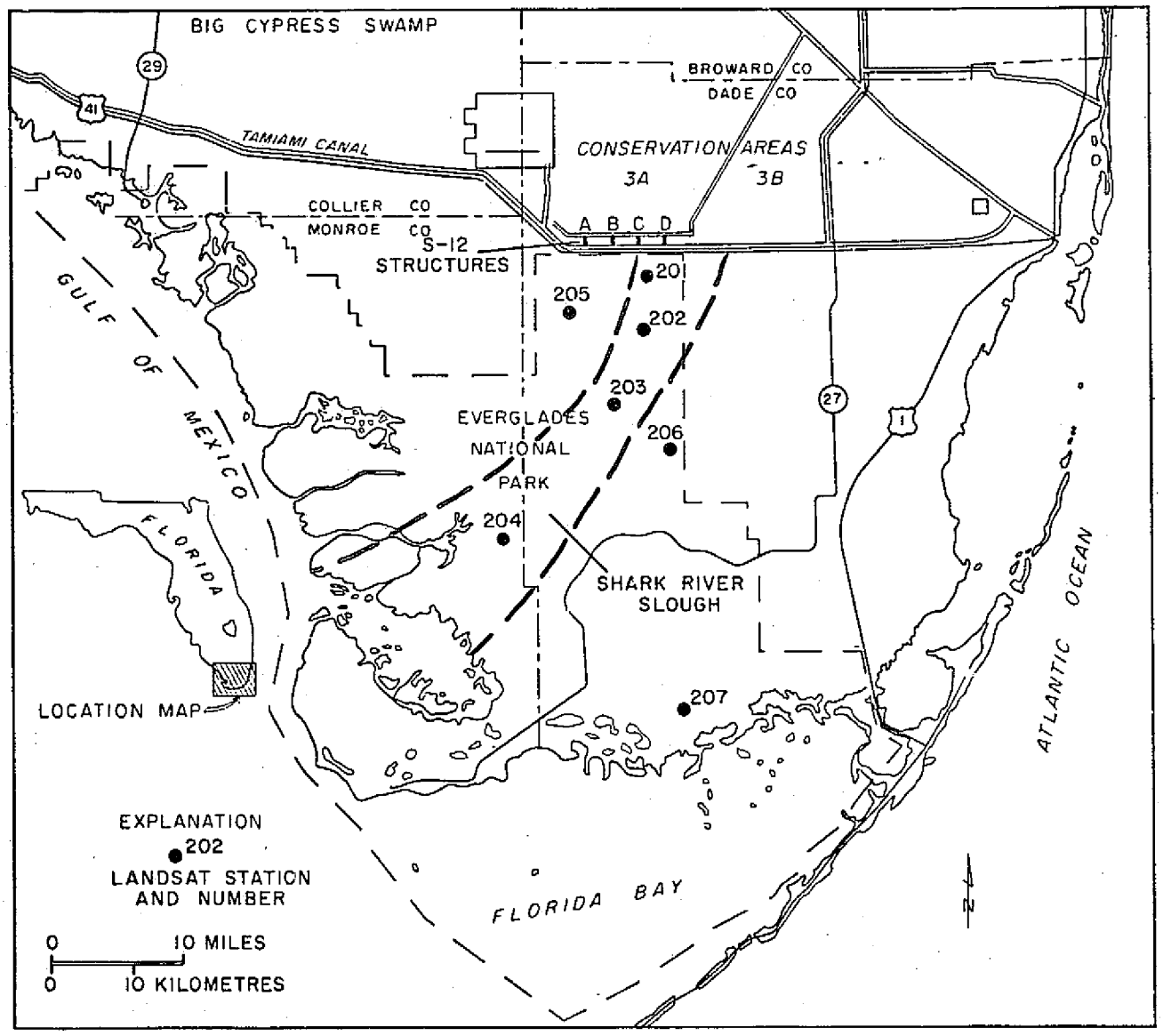

Figure 3.--Landsat stations currently operating in Everglades National Park.

Figure 4.--Landsat Imagery - 1458-15210-7, October 24, 1973. Dark areas indicate water distribution. From January 1973 to June 1974 S-12-A (figure 3) was closed. Water levels had peaked although no surface water is indicated between the west boundary of Everglades National Park and the Buttonwood Embankment (figure 8).

Figure 5.--Landsat Imagery - 1584-15184-7, February 27, 1974. Dark areas indicate water distribution. S-12-A (figure 3) has not been open for one year. The area west of Shark River Slough is dry and the slough has diminished in width. Fires broke out along the west Park boundary six weeks after this image was taken (figure 7).

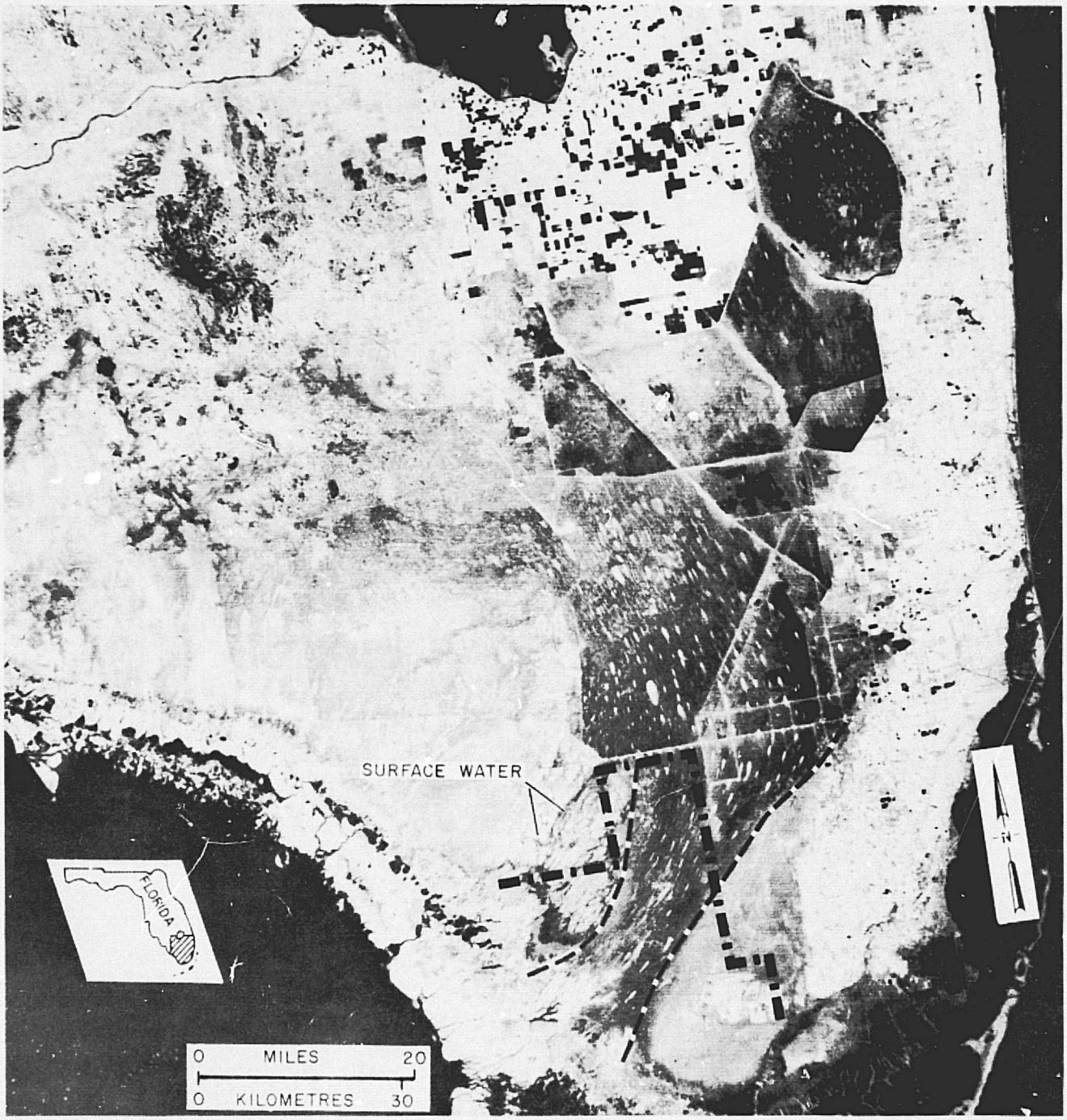

Figure 6.--Landsat Imagery - 1818-15120-7, October 19, 1974. Dark areas indicate water distribution. This image was taken one year after the image in figure 4. S-12-A (figure 3) had been open for five months. Water has now been distributed west of the Park towards the Buttonwood Embankment. No fires of any consequence occurred on the western boundary of the Park during the dry season.

Except for November, 1973, all gates at S-12-A were closed from February 1973 until June 1974. The northwestern corner of Everglades National Park was dry during this time. On April 7, 1974 wildfire #7 "Binky" started and burned until June 11, 1974. "Binky" altered 35,668 acres of park land and 28,059 acres of private property. From May 4, 1974 to July 3, 1974, wildfire #13 "Gator Denn" damaged approximately 13,005 acres, 11,081 acres of which were in the park (fig. 7).

Within the Gator Denn fire area, many hardwoods were burned below ground level. In some areas muck was burned as deep as 3.5 feet and numerous tree islands were burned down to rock. About 40 percent of the bay and willow heads and most of the pond apple stands burned with a loss of about 1 to 2 feet of soil. Some alligator caves burned out and a few alligators were badly burned or killed.

The "Binky" fire area was dry when the fire started; the alligator holes had dried up about a week before the fire started. The fire destroyed numerous hard shell turtles that had buried themselves down in the muck to stay moist. The muck fires continued to burn, even after heavy rains, and were not entirely quenched until the area was entirely inundated.

The wild fires may have caused less damage if the control gates at S-12-A had been open. Landsat data may provide valuable information that will assist in the management of the S-12 structures to take into account the water requirements of the Park between the Buttonwood Enbankment (fig. 8) and the Shark River Slough.

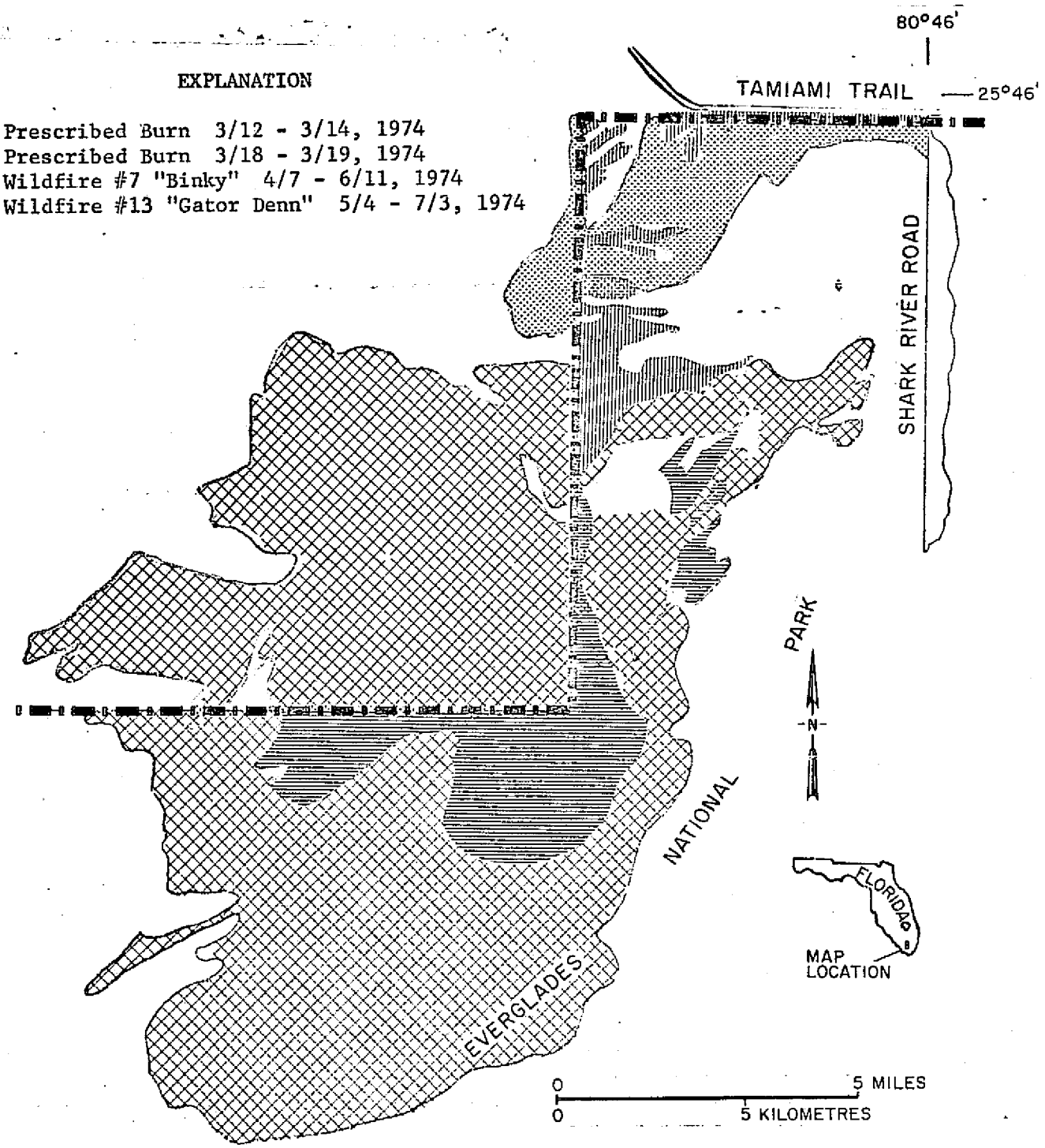

Figure 7.--Areas burned by major fires in Everglades National Park during 1973 and 1974. Adapted from Everglades National Park fire maps. Bancroft, 1975.

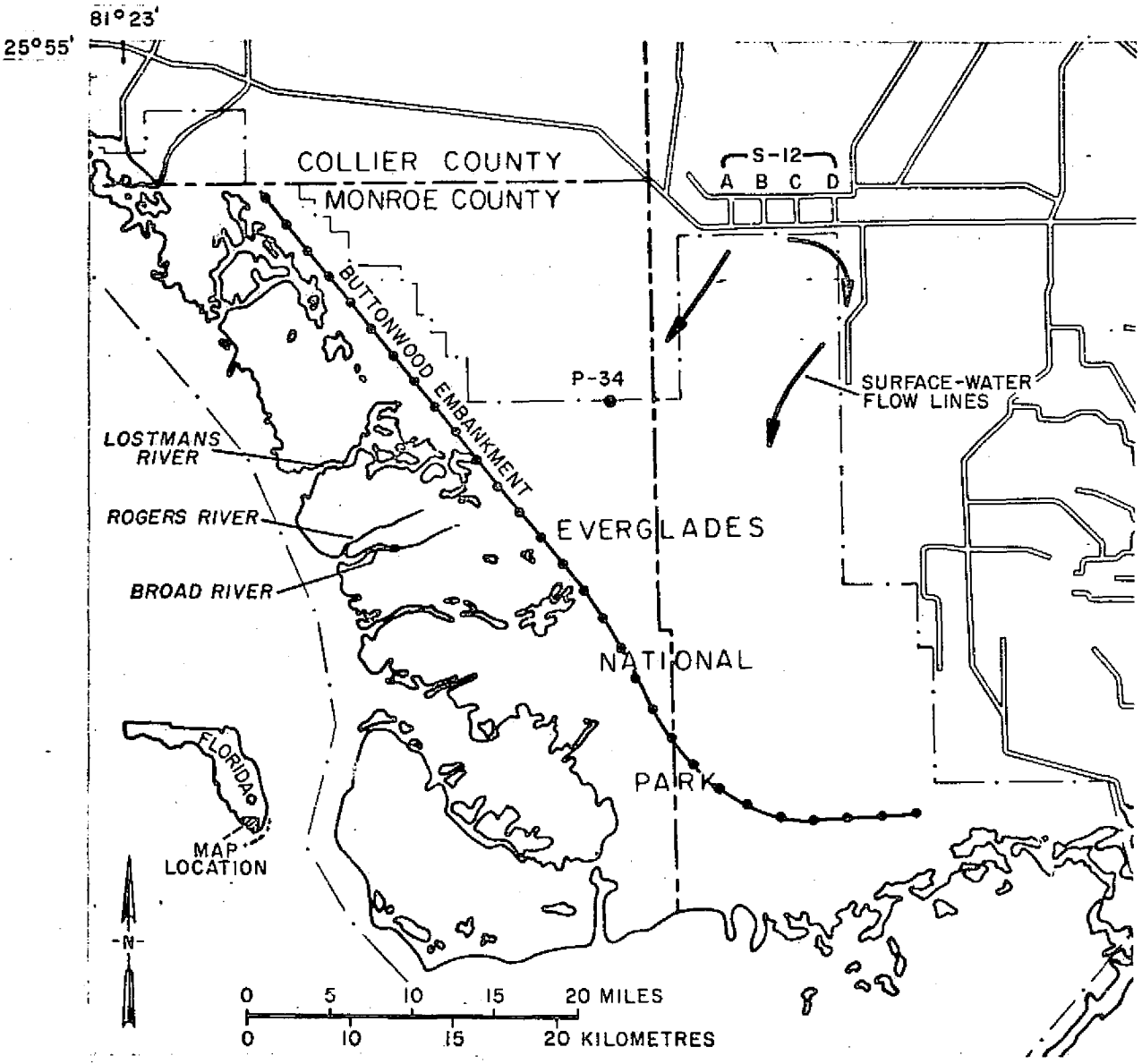

Figure 7... Approximate locations of the Buttonwood Embankment, stage recorder P-34 and S-12-A, B, C and D control gates.

More prescribed burning during safe conditions may be needed to keep fuels at low levels, to lessen the fire damage during severe drought years. Perhaps the management of fire and water that generated this unique environment could perpetuate Everglades National Park for future generations.

Plans are underway for two investigations which will try to describe the water management of the S-12 structures. One investigation is to determine the relationships between water releases at S-12A and S-12-B and water distributions in Everglades National Park, specifically the area known as the Buttonwood Enbankment (fig. 8).

The second investigation is to determine the response time, if any, between surface-water discharge through S-12A and/or S-12-B and water-level changes at P-34 (fig. 8). If any correlation can be determined, the project will then be expanded to correlate discharges at S-12-A, B, C and D with water levels at other downstream stations.

Using Landsat imagery, and DCP data taken at times when the S-12 structures are regulated, could yield important data on spatial and temporal distributions of water in Everglades National Park which are directly related to fire management procedures.

REFERENCES

Davis, J.H., Jr., 1943, The Natural Features of Southern Florida: Florida Geol. Survey Bull. 25, 311 p.

Craighead, F.C., Sr., 1934, Hammocks of South Florida, In Memoir: Miami Geol. Soc., 7 p.

Keetch, J.M. and Byram G.M., 1968, A Drought Index for Forest Fire Control: Southeast Forest Exp. Station, U.S. Department of Agriculture Forest Service Res. SE-38, 32 p.

Bancroft, Larry, 1975, Fire Management in Everglades National Park: Management Report, 29 p.